Town of Fountain Hills
Building Safety Division
One and Two Family Residential
Plan Review

Based upon the 2012 edition of the International Residential Code (IRC)

PLAN CHECK NO: **ADDRESS:** **DATE:**

Reviewed by: Jason Field, Chief Building Official/Plans Examiner (480) 816-5127 jfield@fh.az.gov

Fees: Please see the Town's website for the Comprehensive Fee Schedule:

http://www.fh.az.gov/Data/Sites/2/media/finance/fees.pdf

INSTRUCTIONS:

Conditional Approval. Plans are approved subject to the items checked on this checklist. This is an integral part of the approved plans. All items contained on the list are minimum code requirements and must be complied with if your construction is to receive inspection approvals. The items that are circled are those that are found to be especially applicable to your plans Items may also be circled to remind you of an important code requirement. Every effort has been made to note all necessary corrections during our plan review. However, it is ultimately the responsibility of the builder to perform the construction according to the minimum code requirements, regardless of whether or not items are circled. Approval of the plans does not permit the violation of any part of the Town of Fountain Hills Code.

Resubmittal Required. Plans must be revised and resubmitted for review. Please note the items marked on this list and/ or noted on the plans for required revisions or for the submittal of additional information.

We encourage questions at any time. The person in the Building Safety is noted above and you may contact him to discuss the plan review comments.

Inspection Notes:

The approved plans, along with this list, must be available to the building inspector on the site at the time when inspections are performed. Failure to have the plans, stamped "**APPROVED**," on the site may result in one of the following actions:

- No inspection will be performed or approved;
- A re-inspection fee for the amount foe the amount of $150.00 paid at the Building Safety office prior to scheduling a follow-up inspection;
- Unnecessary delays in construction.

TABLE R301.2 (1)

CLIMATE AND GEOGRAPHIC DESIGN CRITERIA

GROUND SNOW LOAD	WIND SPEED (mph, 3-sec. gust)	SEISMIC DESIGN CATEGORY	SUBJECT TO DAMAGE FROM				WINTER DESIGN TEMP	ICE SHIELD UNDER-LAYMENT REQUIRED	FLOOD HAZARDS	AIR FREEZING INDEX	MEAN ANNUAL TEMP
			Weathering	Frost line depth	Termite	Decay					
0 psf	90	B	Negligible	12"	Moderate to Heavy	None to Slight	34° F.	No	Varies	0	69° F.

Fire Code Amendments. Amendments to the adoption of the International Fire Code (IFC), including automatic fire sprinkler system requirements, are available from the Fountain Hills Fire Department.

MANUAL "J" TABLE 1A
OUTDOOR DESIGN CONDITIONS FOR THE UNITED STATES
(PHOENIX)

Elevation Feet	Latitude Degrees North	Winter	Summer					
		Heating 99% Dry Bulb	Cooling 1% Dry Bulb	Coincident Wet Bulb	Design Grains 55% RH	Design Grains 50% RH	Design Grains 45% RH	Daily Range (DR)
1133	33	37	108	70	-21	-14	-8	H

PLAN REVIEW COMMENTS: The following items briefly summarize the minimum code requirements of the International Residential Code (IRC). For detailed requirements, and, in some cases, exceptions, to the code requirements listed below, please refer to the code sections that are cited in the most current edition of the (IRC).

Administration & General Submittal Requirements — Chapter 1

No.	Description of Minimum Code Requirements
1.	**Project description.** Identify and describe the work to be covered by this permit. **[R105.3** (1)]
2.	**Separate permits.** Fences, retaining walls, swimming pools and spas are to by separate permit. Fountain Hills Fire Department approval is required for propane tank installation
3.	**Address and legal description**. Indicate on the drawings the correct and complete address and legal description **[R105.3 (2)]**
4.	**Site plan.** Indicate the location of the proposed building on the lot, including distances from property lines and any other building(s) on the lot. **[R106.2]**
5.	**Square footage summary.** Provide a square footage summary for each of the following: livable, garage, and covered patios, porches, storage and mechanical.
6.	**Plans.** Provide **three** engineered site plans and **two** sets of construction drawings, including one sheet dedicated to the required energy information, with a maximum sheet size of 24" x 36. The preferred scale is 1/4" = 1'-0," but a scale of 3/16" = 1'-0" may be accepted. Indicate the scale and provide a North arrow. Minimum of 30:1 scale on site plans.
7.	**Framing plans.** Provide complete floor and roof framing and foundation plans. Specify size and spacing of all framing members. Indicate all post locations and sizes, holddowns, headers, beams, hangers and ties, and braced wall lines. **[R106]**
8.	**Details and notes.** Delete or cross out details or notes that do not apply or are not used.
9.	**Engineering.** Engineering, such as a lateral analysis for shear, retaining and gravity when required, shall be sealed, signed and dated by an architect or engineer registered in the state of Arizona in accordance with the applicable state statutes. **[R106]**
10.	**Special inspection.** Special inspection is required for this project. Please complete the attached forms if applicable and return them to Building Safety with other re-submittal documents. **[R109]**
11.	**Manufacturer's installation instructions.** Manufacturer's installation instructions, as required by this code for items such as gas fireplaces, gas logs and other listed appliances, components or specialized systems, shall be available on the job site at the time of inspection. **[R106.1.2]**

12. **Energy conservation items.** Please provide information regarding the "Energy Efficiency" items that are located under **Energy Efficiency** of this document. Note the R-values of insulation to be installed on the plans, and provide notes and/or details that indicate compliance with other energy conservation requirements. **[N1100] see separate handout.**

Building Planning — Chapter 3

No.	Description of Minimum Code Requirements

1. **Minimum glazed openings areas.** All habitable rooms shall be provided with aggregate glazing area of not less than 8 percent of the floor area of such rooms. The minimum openable area to the outdoors shall be 4 percent of the floor area being ventilated. See Section R303 for details and exceptions. **[R303] exceptions may apply.**

2. **Area and height.** Label and dimension all rooms and spaces. Note ceiling height of all rooms and areas. **[R304 / R305]**

3. **Bathroom light and ventilation.** Provide bathrooms or water closet compartments with 3 sq. ft. of window area, one-half of which must be openable, or provide artificial light and mechanical ventilation at a rate of at least 50 cfm intermittent or 20 cfm continuous. **[R303.3]**

4. **Toilet, bath and shower spaces.** Provide 15" clearance from centerline at sides and 21" in front of water closet and space other fixtures in accordance with Figure **[R307/ Figure R307.1]**

5. **Safety glazing.** Provide safety glazing at the following hazardous locations: **[R308]**
R308.4.1 Glazing in doors.
Glazing in all fixed and operable panels of swinging, sliding and bifold doors shall be considered a hazardous location.
Exceptions:
    1. Glazed openings of a size through which a 3-inch-diameter (76 mm) sphere is unable to pass.
    2. Decorative glazing.

6. **R308.4.2 Glazing adjacent doors.**
Glazing in an individual fixed or operable panel adjacent to a door where the nearest vertical edge of the glazing is within a 24-inch (610 mm) arc of either vertical edge of the door in a closed position and where the bottom exposed edge of the glazing is less than 60 inches (1524 mm) above the floor or walking surface shall be considered a hazardous location.
Exceptions:
    1. Decorative glazing.
    2. When there is an intervening wall or other permanent barrier between the door and the glazing.
    3. Glazing in walls on the latch side of and perpendicular to the plane of the door in a closed position.
    4. Where access through the door is to a closet or storage area 3 feet (914 mm) or less in depth. Glazing in this application shall comply with section R308.4.3.
    5. Glazing that is adjacent to the fixed panel of patio doors.

7. **R308.4.3 Glazing in windows.**
Glazing in an individual fixed or operable panel that meets all of the following conditions shall be considered a hazardous location:
1. The exposed area of an individual pane is larger than 9 square feet (0.836 m^2);
2. The bottom edge of the glazing is less than 18 inches (457 mm) above the floor;
3. The top edge of the glazing is more than 36 inches (914 mm) above the floor; and
4. One or more walking surfaces are within 36 inches (914 mm), measured horizontally and in a straight line, of the glazing.
Exceptions:
    1. Decorative glazing.
    2. When a horizontal rail is installed on the accessible side(s) of the glazing 34 to 38 inches (864 to 965 mm) above the walking surface. The rail shall be capable of withstanding a horizontal load of 50 pounds

per linear foot (730 N/m) without contacting the glass and be a minimum of $1^1/_2$ inches (38 mm) in cross sectional height.
3. Outboard panes in insulating glass units and other multiple glazed panels when the bottom edge of the glass is 25 feet.

8. **R308.4.4 Glazing in guards and railings.**
Glazing in guards and railings, including structural baluster panels and nonstructural in-fill panels, regardless of area or height above a walking surface shall be considered a hazardous location.

9. **R308.4.5 Glazing and wet surfaces.**
Glazing in walls, enclosures or fences containing or facing hot tubs, spas, whirlpools, saunas, steam rooms, bathtubs, showers and indoor or outdoor swimming pools where the bottom exposed edge of the glazing is less than 60 inches (1524 mm) measured vertically above any standing or walking surface shall be considered a hazardous location. This shall apply to single glazing and all panes in multiple glazing.

Exception:
Glazing that is more than 60 inches (1524 mm), measured horizontally and in a straight line, from the water's edge of a bathtub, hot tub, spa, whirlpool, or swimming pool.

10. **R308.4.6 Glazing adjacent stairs and ramps.**
Glazing where the bottom exposed edge of the glazing is less than 36 inches (914 mm) above the plane of the adjacent walking surface of stairways, landings between flights of stairs and ramps shall be considered a hazardous location.

Exceptions:
1. When a rail is installed on the accessible side(s) of the glazing 34 to 38 inches (864 to 965 mm) above the walking surface. The rail shall be capable of withstanding a horizontal load of 50 pounds per linear foot (730 N/m) without contacting the glass and be a minimum of $1^1/_2$ inches (38 mm) in cross sectional height.
2. Glazing 36 inches (914 mm) or more measured horizontally from the walking surface.

11. **R308.4.7 Glazing adjacent to the bottom stair landing.**
Glazing adjacent to the landing at the bottom of a stairway where the glazing is less than 36 inches (914 mm) above the landing and within 60 inches (1524 mm) horizontally of the bottom tread shall be considered a hazardous location.

Exception:
The glazing is protected by a guard complying with Section R312 and the plane of the glass is more than 18 inches (457 mm) from the guard.

12. **Site Built.** Shall comply with section 2404 of the International Building Code (IBC)

13. **Garage-dwelling opening protection: [R302.5]**
- **Doors.** Must be at least 1-3/8"-thick solid wood or solid or honeycomb steel or 20-minute fire-rated doors. **[R302.5.1]**
- **Ducts.** Minimum No. 26 gauge sheet steel or other approved material with no duct openings into the garage (or provide listed dampers). **[R302.5.2]**
- **Sleeping rooms.** Openings from a private garage directly into a room used for sleeping are prohibited. **[R302.5.1]**

14. **Garage-dwelling separation.** Separate garage from residence and its attic by 1/2" gypsum board applied to the garage side. Garages beneath habitable rooms shall be separated from all habitable spaces by 5/8" Type 'X' gypsum board. Structural elements supporting such a floor-ceiling assembly shall be protected by 1/2" gypsum board. **[R302.6]**

15. **Garage and carport floors.** Garage floor surfaces must be approved noncombustible materials, with floors sloped to facilitate drainage to a floor drain or the main vehicle entry doorway. **[R309]**

16. **Emergency escape and rescue.** Every sleeping room and basements with habitable space shall have a least one window with minimum 5.7 sq. ft. net clear opening (5.0 sq. ft. at grade floor), minimum opening width of 20", minimum opening height of 24" and a sill height not more than 44"; or provide an exterior door for emergency egress. **[R310]**

17. **Window wells.** Egress windows with finished sill heights located below the adjacent ground level must be equipped with approved window wells (9 sq. ft. and 36" minimum dimension) and, where wells have a vertical depth greater than 44," have an approved permanent ladders or steps. **[R310.2]**

18. **Under stair protection**. Enclosed accessible space under stairs shall have walls, under stair surface and any soffits protected on the enclosed side with ½" (12.7 mm) gypsum board. [R302.7]

19. **Landings at doors.** There shall be a floor or landing on each side of each exterior door. The width shall not be less than the door served with a minimum dimension of 36" measured in the direction of travel. See Section R311.4.3 for details and exceptions to this requirement. The floor or landing at the exterior door shall not be more than 1.5 inches (38mm) lower than the top of the threshold. The exterior landing at an exterior doorway shall not be more than 73/4 inches (196 mm) below the top of the threshold. See exceptions. [R311.3 / R311.3.1]

20. **Stair requirements. Stairways shall meet the following requirements: [R311.7]**
    - **Width.** 36" minimum with handrails allowed to project up to 4.5 inches into the minimum width on either side. **[R311.7.1]**
    - **Headroom.** Not less than 6 ft. 8 in. measured vertically from the plane across the tread nosings or from the floor surface of the landing or platform. **[R311.7.2]**
    - **Treads and risers.** Maximum riser height is 7-3/4 inches. Minimum tread depth is 10 inches. Variation may not exceed 3/8 inch. Nosing's of ¾" – 1¼" must be provided on solid stairs. See R311.5.3 for details & exceptions. **[R311.7.5.1 & R311.7.5.2]**
    - **Winder treads.** Winder treads shall have a minimum tread depth of 10 inches measured 12"from the side where the treads are narrowest, with a minimum tread depth of 6" at any point and no more than 3/8" variation. **[R311.7.5.2.1]**
    - **Landings at stairways.** Provide a floor or landing at the top and bottom of each stairway and so that vertical rise does not exceed 12 ft. between landings. Landings are not required at interior stairs, provided a door does not swing over the stairs. The width of the landing shall not be less than the door served, with a minimum dimension of 36" measured in the direction of travel. **[R311.7.6 & R311.7.3]**
    - **Handrails.** Handrails shall be provided on at least one side of each continuous run of treads or flight with four or more risers. Height shall be 34" - 38" above the nosings of the treads. Handrail grip shall be as per R311.5.6.3. **[R311.7.8, R311.7.3.1, R311.7.8.2]**
    - **Spiral stairways.** Spiral stairways shall have a minimum width of 26," 7.5" minimum tread depth at 12" in from the narrower edge, all treads identical, 9.5" maximum rise and 6'-6" minimum headroom. **[R311.7.10.1]**

21. **Guards (guardrails).** Where porches, balconies or raised floors are more than 30" above the floor or grade below, provide a guard that is: **[R312]**
    - 36" in height. **[R312.1.1]**
    - For open sides of stairs with more than 30" drop, guard height may be 34" above the nosings of the treads.
    - Porches & decks enclosed with insect screening with drop > 30" require guards.
    - Openings in guards may not allow the passage of a 4-inch-diameter sphere. **[R312.1.3]**
    - Triangular opening of stair riser, tread & guard may not allow 6-inch sphere.
    - Openings for required guards on sides of stair treads may not allow a 4-3/8"-diameter sphere to pass through.

22. **Smoke alarms.** Provide interconnected smoke alarms in each sleeping room, outside each sleeping room in the immediate vicinity of the bedrooms and on each story. Smoke alarms shall receive primary power from building wiring (be "hard-wired") with battery backup. The actuation of one alarm will activate all of the alarms in the individual unit. **[R314]**

23. **Carbon monoxide alarms.** For new construction, an approved carbon monoxide alarm shall be installed outside of each separate sleeping area in the immediate vicinity of the bedrooms in *dwelling units* within which fuel-fired *appliances* are installed and in dwelling units that have attached garages. **[R315.1]**

24. **Carbon monoxide detection systems.** Carbon monoxide detection systems that include carbon monoxide detectors and audible notification appliances, installed and maintained in accordance with this section for carbon monoxide alarms and NFPA 720, shall be permitted. The carbon monoxide detectors shall be listed as complying with UL 2075. Where a household carbon monoxide detection system is installed, it shall become a permanent fixture of the occupancy, owned by the homeowner and shall be monitored by an approved supervising station. **[R315.2]**

25. **Alterations, repairs and additions.** When interior alterations requiring a permit occur, or one or more sleeping rooms are added, the dwelling shall be provided with smoke alarms as for new dwellings. See Sections R313.1.1 and R313.2 for details and exceptions. **[R313.1.1 & R313.2]**

26. **Dwelling unit separation.** Dwelling units in **Two-family** dwellings shall be separated from each other by wall and/or floor assemblies having not less than a 1-hour fire-resistance rating. Fire-resistance-rated floor-ceiling and wall assemblies shall extend to and be tight against the exterior wall, and wall assemblies shall extend to the underside of the roof sheathing. **[R302.3]**

27. **Townhouses.** Each townhouse shall be considered a separate building and shall be separated by fire-resistance-rated wall assemblies meeting the requirements of Section R302 for exterior walls. **[R302.2]**
    Exception :
    A common 2-hour fire-resistance-rated wall is permitted for townhouses if such walls do not contain plumbing or mechanical equipment, ducts or vents in the cavity of the common wall.

28. **Back to back boxes.** Outlet boxes on opposite sides of a fire-resistive wall must be separated by a distance of at least 24" or by other approved methods as noted in Exception 1 & 2. Recessed fixtures shall be so installed such that the required fire resistance will not be reduced. **[R302.4.2(1)]**

29. **Premises identification.** Approved numbers or addresses shall be provided so as to be readily visible from the street fronting the property. **[R319]**

30. **Automatic fire sprinkler system.** All new dwelling units as well as additions exceeding 50% of the gross area of the existing structure are to be protected by an automatic fire sprinkler system installed throughout the structure. Please contact the Fountain Hills Fire Department for details, exceptions and additional requirements.

Foundations — Chapter 4

1. **Compaction testing reports required.** Where footings will bear on compacted fill material, the compacted fill shall comply with the provisions of an approved report prepared by a soils engineer or civil engineer. **[R401.2 & R403.1]**

2. **Level footings.** Provide note: "Top of footings shall be level. Bottom of footings are permitted to be sloped not to exceed 10%. Footings shall be stepped where ground slopes more than 10%." **[R403.1.5]**

3. **Retaining walls.** All walls retaining over 4ft. shall be an engineered design per town of Fountain Hills amendment. Indicate location and height of all retaining walls and provide engineering. **[R404.1.3]**

4. **Drainage.** Surface drainage shall be diverted so as to not cause a hazard. Lots shall be graded so as to drain surface water away from foundation walls a minimum of six (6) inches within the first ten (10) feet. **[R401.3]**

5. **Concrete strength.** Specify concrete strength on plans. Minimum 2500 psi. **[R402.2 / Table R402.2]**

6. **Soil bearing pressure.** Note type of soil and soil bearing pressure used in design of footings. Design criteria for non-engineered soil bearing shall be 1500 psi. **[R401.4.1 / Table R401.4.1]**

7. **Footing dimensions.** Dimension footing width, thickness, and depth into undisturbed soil. **[Table R403.1]**

8. **Stem wall dimensions.** Dimension stem wall thickness. **[R404.1 / Table 404.1 (1)]**

9. **Anchor bolts.** Foundation plates and sills shall be attached to the foundation, at a minimum, with ½" bolts spaced not more than six (6') feet apart and embedded at least seven (7") inches into concrete or masonry. Minimum of two bolts per plate section with one bolt located not more than 12 inches(305 mm) or less than seven bolt diameters from each end. Engineering for alternate anchor bolt sizes and spacing may also be provided. **[R403.1.6]**

10. **Treated wood.** Specify foundation grade redwood or approved pressure treated foundation plates and sills for all plates in contact with concrete. **[R319.1]**

11. **Spot Footing or piers.** Specify footing or pier sizes and provide foundation sections. **[R403.1.1]**

12. **Horizontal reinforcement.** Detail at least one (1) No. 4 bar within 12 inches (305 mm)of the top of the wall and one No. 4 bar located 3 inches (76 mm) to 4 inches (102 mm) from the bottom of the footing. **[R403.1.3.1]**

    Vertical reinforcement. Provide #4 dowels at minimum of 48" o.c. from footing to stem. Indicate finished floor elevation on the foundation plan. **[Table R404.1.1(2)]**

13. **Openings for under-floor ventilation.** The minimum net area of ventilation openings shall not be less than 1 square foot (0.0929m$_2$) for each 150 square feet (14m$_2$) of under-floor area. One ventilating opening shall be within 3 feet (914 mm) of each corner of the building. **[R408.1]**

14. **Holddowns.** Required holddowns, or tie-down devices, at exterior posts, columns, and braced walls, as specified on the lateral design or as required for all alternate braced wall panels, shall be shown on the foundation plan.

Floors — Chapter 5

1. **Allowable joist spans.** Specify floor joist species, grade, size, spacing and spans to conform with Tables R502.3.1(1), R502..3.1(2), R502.3.3(1) and R502.3.3(2). **[R502.3]**

2. **Joists under bearing partitions.** Joists under parallel bearing partitions shall be of adequate size to support the load. Double joists that are separated to permit installation of piping or vents shall be full depth solid blocked by 2 X lumber spaced not more than 4 ft. apart. Bearing partitions perpendicular to floor joists shall not be offset from supporting girders or walls by more than the joist depth unless joists are sized to carry the additional load. **[R502.4]**

3. **Floor systems.** Joists framing from opposite sides over a bearing support to lap a min. of 3" and be nailed with min. of three (3) 10d nails or equivalent wood or metal splice. **[R502.6.1]**

4. **Lateral restraint at supports.** Joists shall be supported laterally at the ends by full depth solid blocking, by attachment to a header or rim joist, or by other approved means. I-joists shall be supported laterally as required in the manufacturer's installation instructions. **[R502.7]**

5. **Drilling and notching.** Drilling and notching of joists shall not exceed the limits specified in R502.8, Figure R502.8, or, in the case of engineered wood products, such as I-joists, the limits specified in the applicable engineering and/or manufacturer's instructions. **[R502.8 / R502.8.2]**

6. **Wood structural panel sheathing.** Floor sheathing is to be sized in accordance with Tables R503.2.1.1(1) and R503.2.1.1(2) and fastened according to Table R602.3(1) (6" o.c. on edges and 12" o.c. at intermediate supports) unless noted otherwise on the approved plans. **[R503.2 / R503.2.3]**

Wall Construction (see also separate wall bracing handout) Chapter 6

1. **Stud size, height and spacing.** For bearing walls, laterally unsupported stud height may not exceed 10 feet unless an engineered analysis is provided. 2 X 4s @ 16" o.c. or 2 X 6s @ 24" o.c. may be used for bearing walls for structures of up to 2 stories as long as the 10-ft. unsupported height is not exceeded. **[R602.3.1 / Table R602.3(5)]**

2. **Headers.** Indicate the size of all headers, which are to be sized in accordance with Tables R502.5(1) and R502.5(2) or calculations prepared by an Arizona-licensed architect or engineer. **[R602.7 / Tables R502.5(1), R502.5(2)]**

3. **Fireblocking required.** Fireblocking shall be provided to cut off all concealed draft openings (both vertical and horizontal) and to form an effective barrier between stories, and between a top story and the roof space. Fireblocking shall be provided in the following locations: **[R602.8, R302.11]**
   - In concealed spaces of stud walls, including furred spaces and parallel rows of studs or staggered studs, vertically at ceiling and floor levels, and horizontally at intervals not exceeding 10 feet.
   - At all interconnections between concealed vertical and horizontal spaces such as occur at soffits, drop ceilings and cove ceilings.
   - In concealed spaces between stair stringers at the top and bottom of the run. En- closed spaces under stairs.
   - At openings around vents, pipes and ducts at ceiling and floor level.
   - At cornices for two-family dwellings at the line of dwelling unit separation.

   Fireplace fireblocking. All spaces between chimneys and floors and ceilings through which chimneys pass shall be fireblocked with noncombustible material securely fastened in place. **[R1001.12]**

4. **Wall bracing.** See section **[R602.10 thru R602.12.8]**, for prescriptive wall bracing and alternate braced wall panel's requirements. See the item immediately below for buildings that cannot meet these prescriptive requirements for conventional light-frame structures. **[R602.10]**

5. **Lateral analysis required.** Structure does not meet requirements for use of prescriptive braced wall panels **[602.10]** or alternate braced wall panels. Please submit a lateral analysis prepared by an Arizona-licensed architect or engineer and transfer the resulting specifications from the analysis to the foundation, framing and floor plans, details, etc.

Wall Covering Chapter 7

1. **Gypsum backer.** Water-resistant gypsum backer board at showers or tubs may be used on ceilings only if framing spacing does not exceed 12" o.c. for 1/2"-thick board or 16" o.c. for 5/8"-thick board. Water-resistant gypsum board shall not be installed over a vapor retarder in shower or tub compartments. **[R702.3.8]**

2. **Weather-resistant sheathing paper.** One layer of No. 15 asphalt felt, free from holes and breaks, complying with ASTM D 226 for Type 1 felt or other approved water-resistive barrier shall be applied over studs or sheathing of all exterior walls. Such felt or material shall be applied horizontally, with the upper layer lapped over the lower layer not less than 2 inches (51 mm). Where joints occur, felt shall be lapped not less than 6 inches (152 mm). The felt or other approved material shall be continuous to the top of walls and terminated at penetrations and building appendages in a manner to meet the requirements of the exterior wall envelope as described in Section R703.1. **[R703.2]**

   Exception: Omission of the water-resistive barrier is permitted in the following situations:

1. In detached accessory buildings.
2. Under exterior wall finish materials as permitted in Table R703.4.
3. Under paperbacked stucco lath when the paper backing is an approved water-resistive barrier.

3. **Flashing.** *Approved* corrosion-resistant flashing shall be applied shingle-fashion in a manner to prevent entry of water into the wall cavity or penetration of water to the building structural framing components. Self-adhered membranes used as flashing shall comply with AAMA 711. The flashing shall extend to the surface of the exterior wall finish. *Approved* corrosion-resistant flashings shall be installed at all of the following locations:

1. Exterior window and door openings. Flashing at exterior window and door openings shall extend to the surface of the exterior wall finish or to the water-resistive barrier for subsequent drainage. Flashing at exterior window and door openings shall be installed in accordance with one or more of the following:
   - 1.1 The fenestration manufacturer's installation and flashing instructions, or for applications not addressed in the fenestration manufacturer's instructions, in accordance with the flashing manufacturer's instructions. Where flashing instructions or details are not provided, pan flashing shall be installed at the sill of exterior window and door openings. Pan flashing shall be sealed or sloped in such a manner as to direct water to the surface of the exterior wall finish or to the water-resistive barrier for subsequent drainage. Openings using pan flashing shall also incorporate flashing or protection at the head and sides.
   - 1.2 In accordance with the flashing design or method of a registered design professional.
   - 1.3 In accordance with other approved methods.
2. At the intersection of chimneys or other masonry construction with frame or stucco walls, with projecting lips on both sides under stucco copings.
3. Under and at the ends of masonry, wood or metal copings and sills.
4. Continuously above all projecting wood trim.
5. Where exterior porches, decks or stairs attach to a wall or floor assembly of wood-frame construction.
6. At wall and roof intersections.
7. At built-in gutters.

4. **Weep screed.** Detail a corrosion-resistant weep screed at or below the plate line and at least 4" above finish grade and 2" above paved areas. **[R703.6.2.1]**

5. **Exterior insulation finish systems (EIFS).** All EIFS shall be installed in accordance with the applicable evaluation report, MAG One-Coat specifications and the manufacturer's installation instructions. EIFS shall terminate at least 6" above finish grade. **[R703.9]**

6. **Weather-resistive barrier.** All EIFS installations shall have a weather-resistive barrier between water-sensitive building components and the exterior insulation and a means of draining water to the exterior of the veneer. See sheathing paper and weep screed items above. **[R703.2 / R703.9.1]**

7. **Stone and masonry veneer.** Install stone and masonry veneer over wood or steel framing in accordance with items at right. Veneer may not exceed 30 ft. in height, with an additional 8 ft. allowed on ends, and thickness may not exceed 5 inches. For veneers with current evaluation report approvals, provide 2 copies and install in accordance with evaluation report. **[R703.7 / Table R703.4 / Figure R703.7]**

Roof-Ceiling Construction — Chapter 8

1. **Ceiling joist and rafter spans.** Ceiling joist spans shall be in accordance with Tables R802.4 (1) and R802.4 (2). Rafter spans to be in accordance with Tables R802.5.1 (1) thru R802.5.1 (8). **[R802.4 / R802.5]**

2. **Truss to wall connection.** Trusses shall be connected to wall plates by the use of approved connectors having a resistance to uplift of not less than 175 pounds. **[R802.10.2]**

3. **Uplift resistance.** Roof assemblies which are subject to wind uplift pressures of 20 pounds per square foot (960 Pa) or greater shall have roof rafters or trusses attached to their supporting wall assemblies by connections capable of providing the resistance required in Table R802.11. **[R802.11]**

4. **Roof ventilation.** Enclosed *attics* and enclosed rafter spaces formed where ceilings are applied directly to the underside of roof rafters shall have cross ventilation for each separate space by ventilating openings protected against the entrance of rain or snow. Ventilation openings shall have a least dimension of $^1/_{16}$ inch (1.6 mm) minimum and $^1/_4$ inch (6.4 mm) maximum. Ventilation openings having a least dimension larger than $^1/_4$ inch (6.4 mm) shall be provided with corrosion-resistant wire cloth screening, hardware cloth, or similar material with openings having a least dimension of $^1/_{16}$inch (1.6 mm) minimum and $^1/_4$ inch (6.4 mm) maximum. Openings in roof framing members shall conform to the requirements of **Section R802.7.** Required ventilation openings shall open directly to the outside air.
Exception: Attic ventilation shall not be required when determined not necessary by the code official due to atmospheric or climatic conditions.

5. **R806.2 Minimum vent area.**
The minimum net free ventilating area shall be $^1/_{150}$ of the area of the vented space.
Exception: The minimum net free ventilation area shall be $^1/_{300}$ of the vented space provided one or more of the following conditions are met:
1. In Climate Zones 6, 7 and 8, a Class I or II vapor retarder is installed on the warm-in-winter side of the ceiling.
2. At least 40 percent and not more than 50 percent of the required ventilating area is provided by ventilators located in the upper portion of the attic or rafter space. Upper ventilators shall be located no more than 3 feet (914 mm) below the ridge or highest point of the space, measured vertically, with the balance of the required ventilation provided by eave or cornice vents. Where the location of wall or roof framing members conflicts with the installation of upper ventilators, installation more than 3 feet (914 mm) below the ridge or highest point of the space shall be permitted.

6. **R806.3 Vent and insulation clearance.**
Where eave or cornice vents are installed, insulation shall not block the free flow of air. A minimum of a 1-inch (25 mm) space shall be provided between the insulation and the roof sheathing and at the location of the vent.

7. **R806.4 Installation and weather protection.**
Ventilators shall be installed in accordance with manufacturer's installation instructions. Installation of ventilators in roof systems shall be in accordance with the requirements of Section R903. Installation of ventilators in wall systems shall be in accordance with the requirements of Section R703.1.

8. **R806.5 Unvented attic and unvented enclosed rafter assemblies.**
Unvented *attic* assemblies (spaces between the ceiling joists of the top *story* and the roof rafters) and unvented enclosed rafter assemblies (spaces between ceilings that are applied directly to the underside of roof framing members/rafters and the structural roof sheathing at the top of the roof framing members/rafters) shall be permitted if all the following conditions are met:
1. The unvented *attic* space is completely contained within the *building thermal envelope.*
2. No interior Class I vapor retarders are installed on the ceiling side (*attic* floor) of the unvented *attic* assembly or on the ceiling side of the unvented enclosed rafter assembly.
3. Where wood shingles or shakes are used, a minimum $^1/_4$-inch (6 mm) vented air space separates the shingles or shakes and the roofing underlayment above the structural sheathing.
4. In Climate Zones 5, 6, 7 and 8, any *air-impermeable insulation* shall be a Class II vapor retarder, or shall have a Class III vapor retarder coating or covering in direct contact with the underside of the insulation.
5. Either Items 5.1, 5.2 or 5.3 shall be met, depending on the air permeability of the insulation directly under the structural roof sheathing.
5.1. *Air-impermeable insulation* only. Insulation shall be applied in direct contact with the underside of the structural roof sheathing.
5.2. Air-permeable insulation only. In addition to the air-permeable insulation installed directly below the structural sheathing, rigid board or sheet insulation shall be installed directly above the structural roof sheathing as specified in Table R806.5 for condensation control.
5.3. Air-impermeable and air-permeable insulation. The *air-impermeable insulation* shall be applied in direct contact with the underside of the structural roof sheathing as specified in Table R806.5 for condensation control. The air-permeable insulation shall be installed directly under the *air-impermeable insulation.*
5.4. Where preformed insulation board is used as the air-impermeable insulation layer, it shall be sealed at the perimeter of each individual sheet interior surface to form a continuous layer.

9. **Attic access.** Provide minimum 22" X 30" attic access if attic exceeds 30 sq. ft. in area and 30" in height. Provide 30" of unobstructed headroom above the opening. **[R807.1]**

Roof Assemblies — Chapter 9

1. **Roof drains and scuppers.** Specify size, location and termination points. Use maximum rainfall rate of 3" per hour for sizing roof drains and scuppers. See International Plumbing Code (IPC) for additional requirements. **[R903.4 / IPC 1105, 1106]**

2. **Roof covering type.** Indicate the type of roof covering material(s) and their weight in lbs./sq. ft. Provide evaluation report information where applicable. **[R904]**

3. **Application and attachment.** Roof covering materials shall be attached in accordance with applicable provisions of Section R905, the manufacturer's installation instructions or the requirements of applicable evaluation reports, including underlayment and flashing. **[R905]**

Chimneys and Fireplaces — Chapter 10

1. **Pollution reduction.** All fireplaces must be either gas-fired (gas fireplace unit or permanently installed gas log) or wood-burning units that have been certified or tested and listed as meeting U.S. Environmental Protection Agency (EPA) air quality standards (40 CFR Part 60, Sub-part AAA). Please refer to Town of Fountain Hills Code, Article 7-3, for details. **[TOFH Code, Article 7-3]**

2. **Factory-built fireplaces.** All factory-built fireplaces shall be tested in accordance with UL 127. Provide the evaluation report number and 2 copies. Install in accordance with its listing, including clearances to combustible construction and required hearth dimensions. **[R1004]**

   Decorative shrouds. Decorative shrouds shall not be installed at the termination of factory-built chimneys except where the shrouds are listed and labeled for use. **[RR1005.2]**

3. **Gas logs.** Show gas to fireplace, including piping material, size, length and BTUH input. Provide note stating that fireplace will have a permanent gas log set. **[TOFH Code, Article 7-3-1]**

4. **Exterior air supply.** Factory-built or masonry fireplaces shall be equipped with an exterior air supply to assure proper fuel combustion, including 1/4" mesh screen at termination. **[R1006]**

5. **Gas fireplaces in bedrooms.** Gas fireplaces, gas logs or other gas-fired appliances may not be installed in sleeping rooms or other locations unless they are specifically listed for such installations, or they are: **[G2406.2 / G2407.5]**
   - Direct-vent appliances that obtain all combustion air directly from the outdoors.
   - Gas fireplaces or gas logs for installation in wood-burning fireplaces where the room meets the minimum volume requirements of Section G2407.5.

Energy Efficiency 2006 IRC — Chapter 11

1. **Compliance.** Compliance shall be demonstrated by either meeting the requirements of the 2006 *International Energy Conservation Code,* meeting the requirements of Chapter 11 of the 2006 *International*

Residential Code, and completing the most current version of REScheck found at: ***www.energycodes.gov/rescheck***. **[N1101.2]**

Mechanical — Chapters 13-23

1. **Condensate lines.** Condensate drain lines shall be a minimum size of 3/4" i.d. Where damage to building components will occur due to condensate overflow from drain pans or stoppage in condensate piping, an auxiliary or secondary drain system must be provided in accordance with M1411.3.1. Show locations of termination points for drain lines. **[M1411.3 / M1411.3.1]**

   Water level monitoring devices. On down-flow units and all other coils that have no secondary drain and no means to install an auxiliary drain pan, a water-level monitoring device shall be installed inside the primary drain pan. This device shall shut off the equipment served. **[M1411.3.1.1]**

2. **Attic equipment access.** Equipment located in attics shall be provided with an access opening at least 22" X 30," a passageway 24" wide and no more than 20' long, a 30" X 30" minimum working platform, 30" minimum clear headroom and a receptacle and light. Trusses shall be designed to account for the additional load of attic-mounted equipment. **[M1305.1.3]**

3. **Dryer vent.** Clothes dryers are to be provided with an exhaust duct not to exceed 35 ft. in length. The maximum length allowed is reduced, table M1502.4.4. **[M1502]**

4. **Exhaust fans.** Where toilet rooms and bathrooms are mechanically ventilated, the exhaust capacity shall be 50 cfm intermittent or 20 cfm continuous. Where domestic kitchen cooking appliances are equipped with ducted range hoods or down-draft exhaust systems, fans shall be sized to provide 100 cfm intermittent or 25 cfm continuous ventilation rates. **[M1506]**

Fuel Gas — Chapter 24

1. **Prohibited locations.** Gas-fired appliances shall not be located in, or obtain combustion air from, sleeping rooms, bathrooms, toilet rooms or storage closets. See exceptions for direct vent appliances that obtain all combustion air directly from the outdoors or other situations. **[G2406]**

2. **Combustion air.** Provide adequate combustion air for gas-fired appliances. **[G2407]**

3. **Elevation of ignition source.** Gas appliances and equipment having an ignition source shall be elevated such that the source of ignition is 18" above the floor in hazardous locations or private garages. See exception for specifically listed equipment. **[G2408.2]**

4. **Equipment protection.** Appliances located in private garages shall be installed with a minimum clearance of 6 ft. above the floor OR be protected from motor vehicle impact and installed in accordance with G2408.2, the item immediately above. **[G2408.3]**

5. **Gas pipe sizing.** Provide a gas piping schematic for all gas appliances, including piping type, size, length and Btu hr/ cubic foot rating of all gas-fired equipment. **[G2413]**

6. **Gas piping underground beneath buildings.** If fuel gas piping must be installed underneath a building or slab, it must be within a sealed sleeve and vented to the exterior as described in the referenced code sections. See separate handout with full codes text & diagram. **[G2415.14]**

7. **Makeup air.** When a gas-fired clothes dryer is located in a closet, a minimum opening of 100 sq. Inches shall be provided in the door or makeup air shall be provided by other approved means. **[G2439.4]**

Plumbing — Chapters 25-32

1. **Appliance and fixture locations.** Designate the location of the water heater, furnace, kitchen and laundry appliances and other fixtures. Provide access for service and removal. **[R106]**

2. **Bathtub and shower valves.** The hot water supplied to bathtubs and showers shall be limited to a maximum temperature of 120°F (49°C) by a water temperature- limiting device that conforms to ASSE 1070, except where such protection is otherwise provided by a combination tub/shower valve in accordance with Section P2708.3. **[P2713.3]**

3. **Pressure-Temperature relief valve lines.** Water heaters or other appliances or equipment used for heating water or storing hot water shall be protected by relief valves as required by IRC Section 2803.1. Relief valve lines shall not be directly connected to the drainage system, but shall be piped full size to the floor, to the outside of the building or to an indirect waste receptor inside the building. See IRC Section P2803.6.1 for details. **[P2803.6.1]**

4. **Hose bibbs.** Hose bibbs are to be equipped with integral backflow preventers. **[P2902.4.3]**

5. **Sumps and ejectors.** Provide an engineered sump pump and ejector system if elevation of street is 6' or higher than finished floor elevation. Provide installation specifications from the manufacturer. **[P3007]**

6. **Backwater valves.** Fixtures with flood level rims located below the elevation of the next upstream manhole cover shall be protected from backflow of sewage by installing an approved backwater valve. **[P3008]**

Electrical — Chapters 33-42

1. **Electrical plan.** Provide an electrical plan indicating the receptacles, switches, lights, meter box and size, smoke detectors, carbon monoxide alarms, exhaust fans, GFCI-protected receptacles, etc. **[R106]**

2. **Load calculation.** Provide electrical load calculation for all dwelling units over 3000 square feet (with a 200-amp service) or as deemed necessary by the Building Safety Division. **[E3602.2]**

3. **Service panel.** Indicate the size (rating) and location of the service entrance and any sub panels. Provide a minimum 30W" X 36D" working clearance at all panels and disconnects. **[E3405]**

4. **Location of over current devices.** Sub-panels may not be located in bathrooms, clothes closets, or where they are exposed to physical damage or located higher than 6'ft. 7" inches above the floor. **[E3405]**

5. **Grounding.** A grounding electrode system shall be provided in accordance with IRC E3508. **[E3608]**

6. **Bonding.** Provide bonding for water piping, gas and metal building systems. **[E3609]**

7. **Ranges.** Ranges (with a rating of 8.75 kVA or more) require a minimum 40-amp branch circuit. **[E3702.9]**

8. **Kitchen and dining and breakfast area receptacles.** Two (2) or more 20-amp small appliance circuits are required in kitchens. **[E3703.2]**

9. **Laundry circuit.** A minimum of one 20-amp branch circuit is required to serve a laundry room or area and shall serve only outlets in that room or area. **[E3703.3]**

10. **Bathroom circuit.** A minimum of one 20-amp branch circuit is required to supply the bathroom receptacle outlets and shall have no other outlets. **[E3703.4]**

11. **Wall receptacles.** Provide receptacles along walls (two or more feet in length) so that no point along the wall is more than 6 feet from an outlet. **[E3901.2.1]**

12. **Counter receptacles.** Receptacle outlets shall be installed at each counter space wider than twelve (12) inches so that no point along the counter space is further than 24" from an outlet. **[E3901.4]**

13. **Island and peninsula counter spaces.** Provide at least one receptacle outlet at all island and peninsula counter spaces with long dimensions greater than 24" and short dimensions greater than 12 inches. And one on each side of island counters which have sinks or cook tops installed. **[E3901.4.2] / E3901.4.3]**

14. **Outdoor outlets.** At least one moisture-resistant GFCI-protected receptacle outlet accessible at grade level (within 6'- 6" of finished grade)shall be installed on the exterior at both the front and back of each dwelling unit . **[E3901.7]**

15. **Hallways.** Provide a receptacle in hallways greater than 10 ft. in length. **[E3901.10]**

16. **HVAC outlet.** Provide a receptacle for the servicing of heating, air-conditioning and refrigeration equipment on the same level and within 25' of the equipment. **[E3801.12]**

17. **GFCI protection.** Identify on plans that all receptacle outlets in bathrooms (one adjacent to each basin),garages, at kitchen countertop surfaces, outdoors, and within six (6) feet of bar and laundry sinks must be GFCI protected. **[E3902]**

18. **Arc-fault circuit interrupters, bedroom outlets.** Provide arc-fault circuit interrupter protection for all branch circuits that supply 125-volt, single-phase, 15- and 20-ampere outlets. Such arc-fault circuit interrupter devices shall be combination type. **[E3902.12]**

19. **Lighting outlets.** Designate the location of all required light fixtures (NEC 210.70), including at least one switch-controlled light fixture in every habitable room and bathroom. In other than kitchens and bathrooms, one or more receptacle outlets controlled by a wall switch may be used. **[E3903.2]**

20. **Additional locations.** Show at least one wall switch-controlled lighting outlet in hallways, stairways and attached garages; and to provide illumination on the exterior side of each outdoor egress door having grade level access. At interior stairways with 6 or more risers, there shall be a wall switch at each level. **[E3903.3]**

21. **Disconnecting means.** Provide a disconnect near and in sight of mechanical equipment, including air conditioning condensing units and heat pump units.

22. **FLEXIBLE CORDS. Where permitted.** Flexible cords shall be used only for the connection of appliances where the fastening means and mechanical connections of such appliances are designed to permit ready removal for maintenance, repair or frequent interchange and the appliance is listed for flexible cord connection. Flexible cords shall not be installed as a substitute for the fixed wiring of a structure. **[E3809.1]**

Air Conditioning
Contractors of America

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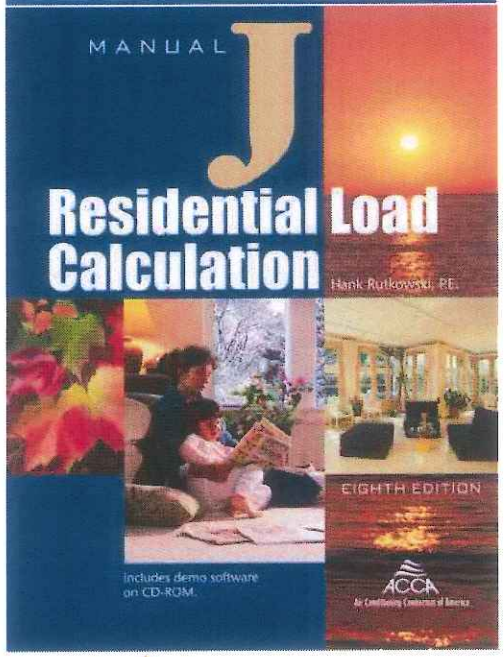
The Air Conditioning Contractors of America (ACCA) is dedicated to excellence in the heating, ventilation, air conditioning and refrigeration (HVACR) industry. As the largest HVACR contractor organization, ACCA is committed to helping its members succeed. Some of the fundamental ways in which our efforts are seen, are in the technical resources and industry standards, that guarantee quality HVACR design, installation and maintenance.

Sponsored by the ACCA Code Committee

The ACCA Code Committee was formed to address code issues and in particular, *to advise and assist ACCA in beneficially representing the contractors in the code processes that affect the HVACR industry*. This information has been provided for entities, seeking to verify that load calculations for an HVACR application have been correctly performed. For more information, contact:

Surumi Hudacsko
Phone: 703-824-8847
Fax: 703-575-9147

Verifying ACCA Manual J® Procedures



Includes load calculation checklist

ACCA
AIR CONDITIONING CONTRACTORS OF AMERICA

WHY ARE HEAT LOSS AND HEAT GAIN CALCULATIONS IMPORTANT

Achieving occupant satisfaction is the principal goal of any HVAC design. Primary factors impacting occupant satisfaction include: filtration, temperature and humidity control, air motion in the room, adequate ventilation, interior zoning needs and energy efficient operation. Occupant satisfaction is maximized when the heating and cooling system and equipment are the correct type and size and the air distribution system is properly designed and installed.

For residential applications, ACCA's Manual J, Eighth Edition (MJ8™) is the only procedure recognized by the American National Standards Institute (ANSI) and specifically required by residential building codes. Methods not based on actual construction details, nor founded on relevant physical laws and engineering principles, are unlikely to result in correct equipment sizing.

PROBLEMS WITH OVERSIZED EQUIPMENT

Oversized equipment results in marginal part load temperature control. While the temperature control at the thermostat may be satisfactory, equipment cycling may cause noticeable temperature swings in other rooms and larger temperature differences between rooms. Oversized equipment may cause degraded humidity control and increase the potential for mold growth, allergic reactions and respiratory problems. In these unfavorable conditions, occupants may experience additional discomfort and dissatisfaction. Other negative effects are higher installed costs, increased operating expenses, and increased maintenance costs. Furthermore, oversized equipment generally requires larger ducts, poses additional requirements on the power grid and may lead to more service calls.

REASONS FOR OVERSIZED EQUIPMENT

Three main reasons for oversized equipment are: (1) a guess is made on the load; (2) mistakes are made in the load calculation; (3) the equipment is selected for either unusual/extreme conditions such as abnormal temperatures or unusual occupancy loads (i.e. gatherings/parties). Other reasons include the use of inappropriate and inadequate "rules of thumb" such as '500ft^2/ton', '400CFM/ton', or 'total cooling capacity = 1.3 x sensible cooling capacity'. Furthermore, seemingly trivial mistakes such as ignoring building efficiency upgrades and assuming that the original design and installation are correct, all contribute towards inappropriate equipment sizing.

MANUAL J® VERIFICATION

While it is not practical to verify every aspect of a submitted MJ8 calculation, it is a good practice to review key elements that indicate general integrity of the calculations i.e. the contractor has made a good faith effort to provide reasonably accurate loads.

ITEMS TO VERIFY

The key load elements, grouped in roughly decreasing levels of impact on the overall contribution to the loads, are:

IMPACT ON LOAD

HIGH	✓ Design Temperatures (Indoor and Outdoor) ✓ Windows, Glass Doors and Large Skylights (shading, overhangs, etc.) ✓ Ducts (location, leakage and duct wall R-values) ✓ Ceilings under an attic (R-values, roof material, roof color)
MEDIUM	✓ Small Skylights ✓ Infiltration ✓ Ventilation
LOW	✓ Appropriately Insulated Floors ✓ Appropriately Insulated Walls ✓ Internal Gains

It is also worth noting some unusual items that also contribute to the load. These include:

- Hot Tubs
- Whirlpool Tubs
- Three-season Porches

A NOTE ON UNDERSTANDING THE DESIGN PROCESS

Manual J allows contractors to perform a load calculation on a residential building/home. Apart from the load calculation being performed, the ducts must be sized and the correct size equipment must be selected. ANSI-recognized ACCA Manual D® for duct sizing and ACCA Manual S® for residential equipment selection provide guidance here.

The order of this checklist follows Form J1 of ACCA Manual J8®.

#	KEY ITEM	CHECK	QUESTIONS TO ASK	CIRCLE ANSWER*		
1	DESIGN TEMPERATURES	✓ Indoor Design Temperatures	Is the indoor design temperature for *Heating*: per Local Code OR 70°F (21°C) at 30% RH?	YES	NO	-----
			Is the indoor design temperature for *Cooling*: per Local Code OR 75°F (24°C) at 50% RH? [or 55% for humid climate, 45% for dry climate?]	YES	NO	-----
		✓ Outdoor Design Temperatures	Is the outdoor design temperature per Table 1 of MJ8 or Local Code?	YES	NO	-----
2	WINDOWS & GLASS DOORS	✓ U-values and SHGC values	Are the SHGC and U-values reasonable for the window types and frame constructions? (see Table 2 of MJ8)	YES	NO	-----
		✓ Shading Adjustments	Have window shading (curtains, drapes, insect screens, tinting, etc.) adjustments been made?	YES	NO	-----
		✓ Overhang Adjustments	Have roof overhang adjustments been made?	YES	NO	-----
		✓ Total Area	Is the total area for the windows & glass doors roughly equal to the area shown on the drawing plans?	YES	NO	-----
		✓ Exposure Directions	Do the exposure directions [North (N), North-East (NE), etc.] appear correct?	YES	NO	-----
3	SKYLIGHTS	✓ U-values and SHGC values	Are the SHGC and U-values appropriate for the skylight types and frame constructions? (see Table 2 of MJ8)	YES	NO	N/A
		✓ Shading Adjustments	Have adjustments been made for drapes, tinting and reflective coatings?	YES	NO	N/A
		✓ Total Area	Is the total area for the skylights roughly equal to the area shown on the drawing plans?	YES	NO	N/A
		✓ Exposure Directions	Do the exposure directions [North (N), North-East (NE), etc.] appear correct?	YES	NO	N/A
4	DOORS | WOOD, METAL	✓ *None*	----------	-----	-----	-----
5	WALLS | ABOVE GRADE, BELOW GRADE	✓ Insulation	Are correct wall insulation R-values taken into account when the wall loads are calculated?	YES	NO	-----
		✓ Total Area	Is the total area for the walls equal to the area shown on the drawing plans?	YES	NO	-----
6	CEILINGS	✓ Insulation	Is correct ceiling insulation R-value taken into account when the ceiling load is calculated?	YES	NO	N/A
		✓ Radiant Barrier	If applicable, does the load calculation take credit for a radiant barrier?	YES	NO	N/A
		✓ Roof color and material	Is correct roof color and material taken into account when the ceiling load is calculated?	YES	NO	-----
		✓ Total Area	Is the total area for the ceilings equal to the area shown on the drawing plans?	YES	NO	-----
7	FLOORS	✓ Insulation	Is the floor insulation and type of construction representative of what is built/planned?	YES	NO	-----
8	INFILTRATION	✓ Envelope Tightness	Is the listed envelope tightness (tight, semi-tight, average, semi-loose, loose) appropriate?	YES	NO	-----
		✓ Above grade volume	Is the total above grade volume equal to what is shown on the drawing plans?	YES	NO	-----
9	INTERNAL GAINS	✓ Appliances	Are the appliance gains 1200 Btuh, 2400 Btuh or a value recommended by MJ8?	YES	NO	-----
		✓ Occupants	*Is Maximum Number of Occupants = Number of Bedrooms + 1?*	YES	NO	-----
			- Is Btuh (cooling) = 230 x Number of Occupants? - Is Btuh (heating) = 200 x Number of Occupants?	YES	NO	-----
10	DUCTS	✓ Duct Location	If located in an unconditioned space, are the ducts insulated (appropriate R-value)?	YES	NO	N/A
		✓ Duct Tightness	Is the duct tightness category 'average sealed' or higher (i.e. notably sealed, extremely sealed)?	YES	NO	-----
11	VENTILATION	✓ Intermittent Fans	Are intermittent bathroom and kitchen fans excluded from the infiltration calculations?	YES	NO	N/A
		✓ Continuous Exhaust Fans	Are dedicated exhaust fans (continuous) included in the calculations?	YES	NO	N/A
		✓ Heat Recovery Equipment	Are the heat recovery equipment and/or a ventilating dehumidifier included in the calculations (if applicable)?	YES	NO	N/A

*Questions should be answered 'YES' (where applicable) to achieve representative load calculations.

Sponsored by the ACCA Code Committee

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For a more detailed analysis on the design process

or visit

www.acca.org/tech/articles/

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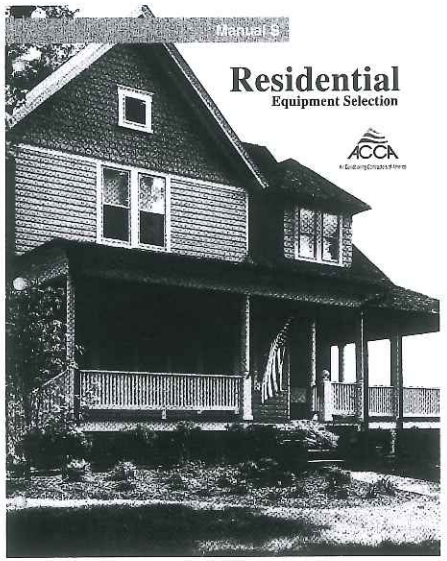

Includes Equipment Selection Checklist & Example

ACCA
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Verifying ACCA Manual S® Procedures

Why is proper equipment selection important?

Achieving occupant satisfaction is the principal goal of any HVAC design. Occupant satisfaction is maximized when the heating and cooling equipment are the correct type and size to meet the capacity requirements from the Manual J load calculation.

For residential equipment selections, ACCA's Manual S®, is the only procedure recognized by the American National Standards Institute (ANSI). If the Manual J load calculation is done then the next step is to select the equipment that will deliver the necessary heating and cooling.

ACCA'S
Design Manuals
Residential

What problems come from the wrong size equipment?

Undersized equipment will not meet the customer's comfort requirements at the design specifications.

Oversized equipment will create other problems:

- Degraded humidity control in the summer.
- Occupants may suffer the effects of an increased potential for mold growth. These same conditions also may contribute to asthma and other respiratory conditions.
- The temperature may feel right at the thermostat but the temperature in other rooms will suffer from the oversized equipment going through short operation cycles. Short cycles can cause temperature swings as the equipment over-conditions, stops, then over-conditions, etc…
- Hot and cold spots between rooms because the thermostat is satisfied but the room is not.
- Oversized equipment generally requires larger ducts, increased electrical circuit sizing and larger refrigeration tubing. These cause higher installed costs and increased operating expenses.
- The equipment starts and stops more frequently, this causes excessive wear and can increase maintenance costs more service calls.

In these unfavorable conditions occupants will experience discomfort and dissatisfaction.

What are some reasons for oversized equipment?

Two main reasons for oversized equipment are either that: (1) a guess was made on the equipment's capacity at the design conditions or (2) that mistakes were made in the selection process. Manufacturers take great care in measuring and testing how well their equipment performs at different operating conditions. When contractors use this data to select the equipment they will meet the heating and cooling needs of their customers.

Equipment Selection Checklist

#	Key Item	Verify	Verification Questions
1	Design Conditions	The design conditions fall within specifications.	Do the design conditions fall within the minimum standards for this region as found in Manual J8 Table 1A or 1B? (A)
		The information from the Manual J load calculation was transferred accurately.	Was the Total Heat Gain / Loss information used to evaluate equipment candidates? (B)
2	Manufacturer's Performance Data	The equipment manufacturer's performance parameters match the design parameters used to calculate the heat load.	Does the manufacturer's performance parameters match the design parameters used to calculate the home's heat load (i.e., outdoor dry-bulb, indoor dry-bulb, and indoor wet-bulb)?
			If the performance data parameters are more than 5% greater or less than the design parameters then did the contractor interpolate the equipment manufacturer's performance parameters to match the design parameters used to calculate the heat load?
3	Equipment Performance	Estimated Cooling – CFM based on Temperature Difference	Was the Sensible Heat Ratio calculated? (Sensible Load / Total Load)? (C)
			Was the SHR used to find the proper air flow? (D)
		Equipment selected satisfies Total Btus (for cooling the Sensible and **Latent** load)	Is the total heating capacity of the selected equipment ≤140% of the designed total heating load? (If so reduce equipment size) (E)
			Is the total cooling capacity of the selected equipment ≤115% of the designed total cooling load ? (If so reduce equipment size) (F)
			Does the "Sensible" and/or "Latent" capacities of the selected equipment meet the load's requirements? (G)
			If a heat pump in a very cold climate (heating is primary concern) does the total cooling capacity of the selected equipment exceed 125% of the designed total cooling load?
4	Auxiliary Heat	Heat Pump Balance Point	Does the electric auxiliary heat provide the necessary BTUs to makeup difference in capacity from the heat pump's balance point to the design load conditions? (H)

Equipment Selection Example using the Checklist

Design

Winter Design Conditions

Outdoor °F:	27°F (A)	From Manual J8 Table 1A or 1B
Indoor °F:	70°F	Manual J8 §3-6 defaults to 70°F
Total Calculated Heat Loss	50,981Btu/h (B)	Determined by Manual J8 load calculation

Summer Design Conditions

Outdoor°F:	85°F (A)	From Manual J8 Table 1A or 1B
Indoor °F:	75°F	Manual J8 §3-6 defaults to 75°F
Entering Wet Bulb (EWB):	63°F	Manual J8 §3-6 defaults to 63°F EWB (≈ 75°F / 50% RH)
Total Heat Gain	27,543Btu/h (B)	Determined by Manual J8 load calculation
Sensible Heat Gain	23,321Btu/h (G)	
Latent Heat Gain	4,222Btu/h (G)	
Sensible Heat Ratio (SHR)	85% (C)	See formula below
Design Air Flow	400cfm/ton (D)	See Chart below, nominally CFM is 350-450 CFM/Ton depending on design conditions

$$SHR = \frac{\text{Sensible Heat}}{\text{Total Heat Gain}} \quad (C) \qquad 85\% = \frac{23{,}321\text{Btu/h}}{27{,}543\text{Btu/h}}$$

Sensible Heat Ratio to CFM per Ton	
SHR	Recommended Air Flow
Below 0.80	350 cfm/Ton
0.80 – 0.85	400 cfm/Ton
Above 0.85	450 cfm/Ton

(D) 85% ≈ 400cfm/ton

Application Data: Equipment Capacity

A furnace was selected for comparing "heating only" design and performance. Other types of equipment may be used.

Furnace Model Number:	FU600300	Fictitious furnace
Output BTUH:	52,000Btu/h (F)	Furnace Btu/h Output: (≤ 140% of calculated loss)

A heat pump was selected for comparing cooling and heating design and performance. Other types of equipment may be used.

Outdoor Unit Model Number:	HP-030	Fictitious heat pump
Total Cooling Capacity (≤ 115%)	28,400Btu/h (F)	These capacities are from manufacturer's performance data at the **DESIGN CONDITIONS:** 85°F ODT, 1,000CFM, and 63°F EWB
Sensible Cooling Capacity (≈ Sensible Gain)	21,600Btu/h (G)	
Latent Cooling Capacity (≈ Latent Gain)	6,800Btu/h (G)	
Indoor Unit Model Number:	AH-030	Fictitious air handler
Indoor Blower CFM (CFM used to determine capacity in manufacturer's performance data):	1,000 (G)	Can the indoor blower deliver design airflow on Medium fan speed
Btuh Difference between Heat Pump Balance Point and Total Heat Loss	30,281 Btu/h (H)	This heat pump can only produce 20,700Btu/h at design conditions. More capacity is required. Air Conditioners do not have a balance point.
Auxiliary Heat (Circle): Electric Gas Oil	10 KW (H)	In this example the auxiliary heat is electric, the formula for electric heat is KW= Btu/h ÷ 3.413

From Manual J8 Tables | From Manual J8 Load Calculation | From Equipment Performance Data

Verifying ACCA Manual D® Procedures

Why are duct design calculations important?

Achieving occupant satisfaction is the principal goal of any HVAC design. For residential air duct designs ACCA's Manual D is the procedure recognized by the American National Standards Institute (ANSI) and specifically required by residential building codes. Air is the first word in air conditioning. If the network of ducts carrying the air is not properly designed then the health and safety of the occupant are at risk, the equipment could fail more quickly, the energy costs could rise, and occupant comfort might be sacrificed.

What problems come from wrong sized ducts?

In order for home owners to be comfortable a duct system must be designed to carry the right amount of air, at the right speed, into the right room. If the ducts are the wrong size then the wrong amount of air will enter the room and may cause:

- The room to be too warm or too cool
- The air to be too drafty and disturb people while they sleep, eat, read, etc...
- The air to be too noisy and drown out conversations, TV or radio programs, etc...
- The air to be too slow – the conditioned air will not circulate or mix well in the room.
- The fan to work harder, possibly fail sooner, and use more energy to move air
- The furnace or air conditioner safety devices to stop equipment operation
- Pressure differentials that may increase energy costs by pushing out conditioned air or drawing in unwanted air

For a more detailed analysis on the design process

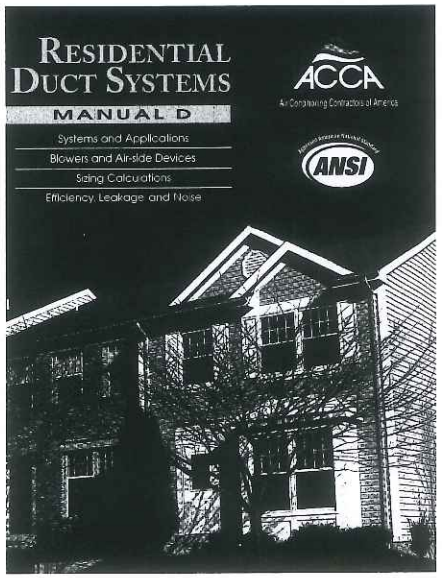
or visit

www.acca.org/tech/articles/

To order ACCA Manual D

888-290-2220

Verifying ACCA Manual D®



Includes Duct Inspection Checklist

ACCA
AIR CONDITIONING CONTRACTORS OF

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ACCA's Manual D Residential Duct Design Checklist		
Key Item	Check	Questions to Ask
Information from load calculation	CFM for each room	Does each room have a heating and cooling CFM assigned? (Proportioned air supply based on Manual J8 room-by-room load calculations) (F)
Manufacturer's Data	Manufacturer's External Static Pressure (ESP)	According to the manufacturer's data will the fan produce the specified airflow at the specified static pressure? (Manufacturers produce a graph that relates air flow and static pressure) (A) (B)
	Accessory and device pressure losses	Did the contractor submit the manufacturer's data specifying the pressure drop for any item in the air stream like a high efficiency filter or a hot water coil? (C)
Manual D Friction Worksheet	Available Static Pressure (ASP)	Are supply outlets, return grilles, and balancing dampers listed at a standard 0.03?
		Are the pressure drops listed for other external devices: filters, coils, etc...? (C)
	Total Effective Length (TEL)	Did the contractor calculate the TEL by adding the longest Supply Total Effective Length and the longest Return Total Effective Length? (Total Effective Length = the length of the duct from outlet back to unit + the effective length for all fittings, i.e., elbows, reducers, take-offs, etc…) (D)
	Friction Rate design value	Did the contractor use the Friction Rate Chart or calculate Friction Rate [FR = ASP x 100 / TEL] (E)
Air Distribution System Design	Branch Lead Size	Did the contractor size the ducts based on the design CFM, friction rate, and the duct material used? (G)
	Trunk Size	Did the contractor select a supply trunk duct large enough to accommodate all the supply branch leads?
	Return Trunk Duct Velocities	Did the contractor select the return trunk duct large enough to meet the lower return air velocity requirements? (H)
	Return air path	Verify each occupied room has an open air path (ACCA recommends a ducted return for each bedroom, den, library, etc…)
Manual T	Register and Grille Face Velocities	Does the air velocity across the register or grille exceed the Recommended Velocity Chart? (Grille manufacturers list the face velocity for grilles and registers at a given CFM, e.g., 12 x 4 - Model XYZ, 500fpm at 120cfm (I)

Friction Rate Worksheet

Step 1) Manufacturer's Blower Data

External Static Pressure (ESP) = 0.70 IWC CFM= 1200 CFM

Step 2) Device Pressure Losses (DPL)

Direct expansion refrigerant coil	0.23 IWC
Electric heat resistance coil	
Hot water coil	
Filter	0.18 IWC
Humidifier	
Supply outlet	0.03 IWC
Return grille	0.03 IWC
Balancing dampers	0.03 IWC
Other device	
Total device losses	0.50 IWC

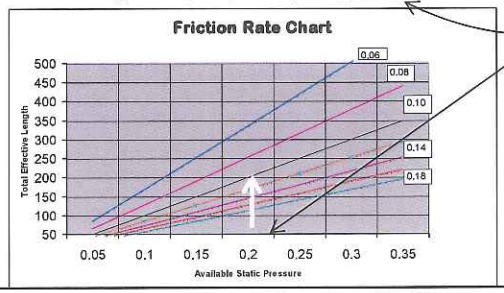
Step 3) Available Static Pressure (ASP)

ASP = ESP – DPL (Step 1 – Step 2) 0.20 IWC

Step 4) Total Effective Length (TEL)

Supply side TEL + Return side TEL = 200 ft TEL

Step 5) **Friction Rate** Design Value [FR= (ASPx100)÷TEL] 0.10 IWC from chart below



A From manufacturer's data—equipment CFM at rated capacity

B From Manufacture's Blower Performance Data corresponding to the CFM

C From Manufacturer's Performance Data

D **Total Effective Length** ≈ loss from duct lengths, reducers, elbows and other fittings

E **Friction Rate** is found by reading bottom scale to 0.20 and up the side scale to 200 feet the intersecting line is the 0.10. That is the design friction rate. This example, 0.10, is within the acceptable friction rate range.

F The **Design CFM** for each room is based on the larger of the Cooling or Heating CFM. Those heat and cool CFM come from the allocation of the system's capacity based on each room's heating and cooling needs.

Table of Useful Air Distribution System Design Information

Zone:	One	Design Friction Rate	0.10	Type of System:	Trunk and Branch
Construction Material	Supply Air Trunk	Metal		Supply Air Branch	Flex
Construction Material	Return Air Trunk	Duct board		Return Air Branch	Flex
R-Value of Insulation	Supply	R6		Return	R6

Room	Design CFM	Supply Duct Size(s)	Supply Grille(s) Size, and Velocity	Return Duct Size(s)	Return Grille Size and Velocity
Bedroom 1	150	1 - 8"	1 - 14x6, 600fpm	(9")- 12"	14x14, 300fpm
Walk-in-Closet	15	1 - 4"	1 - 8x4, 450fpm		
Bedroom 2	100	2 - 6"	2 - 10x4, 600fpm	(7") - 8"	14x8, 275fpm
Bedroom 3	100	1 - 7"	1 - 12x4, 600fpm	(7") - 8"	14x8, 275fpm
Living Room	275	2 - 8"	2 - 14x6, 575fpm	(16")- 18"	24x24, 350fpm
Den	125	1 - 8"	1 - 14x6, 600fpm		
Dining	125	2 - 6"	2 - 10x4, 600fpm		
Foyer	80	1 - 6"	1 - 10x4, 600fpm		
		2 - 6"	2 - 10x4, 625fpm		
Bath 1	65	1 - 6"	1 - 10x4, 600fpm		
Bath 2	40	1 - 5"	1 - 8x4, 500fpm		
Bath 3					
TOTALS	1200				

G The **Friction Rate** is used to determine the duct size.

H The **return duct size** is based on the friction rate and then may be adjusted to a larger size to meet recommended velocity.

I **Grille and register sizes** should be selected to ensure the velocities are acceptable.

ACCA does not recommend installing return ducts in kitchens, baths, laundry, or utility rooms

Notes:

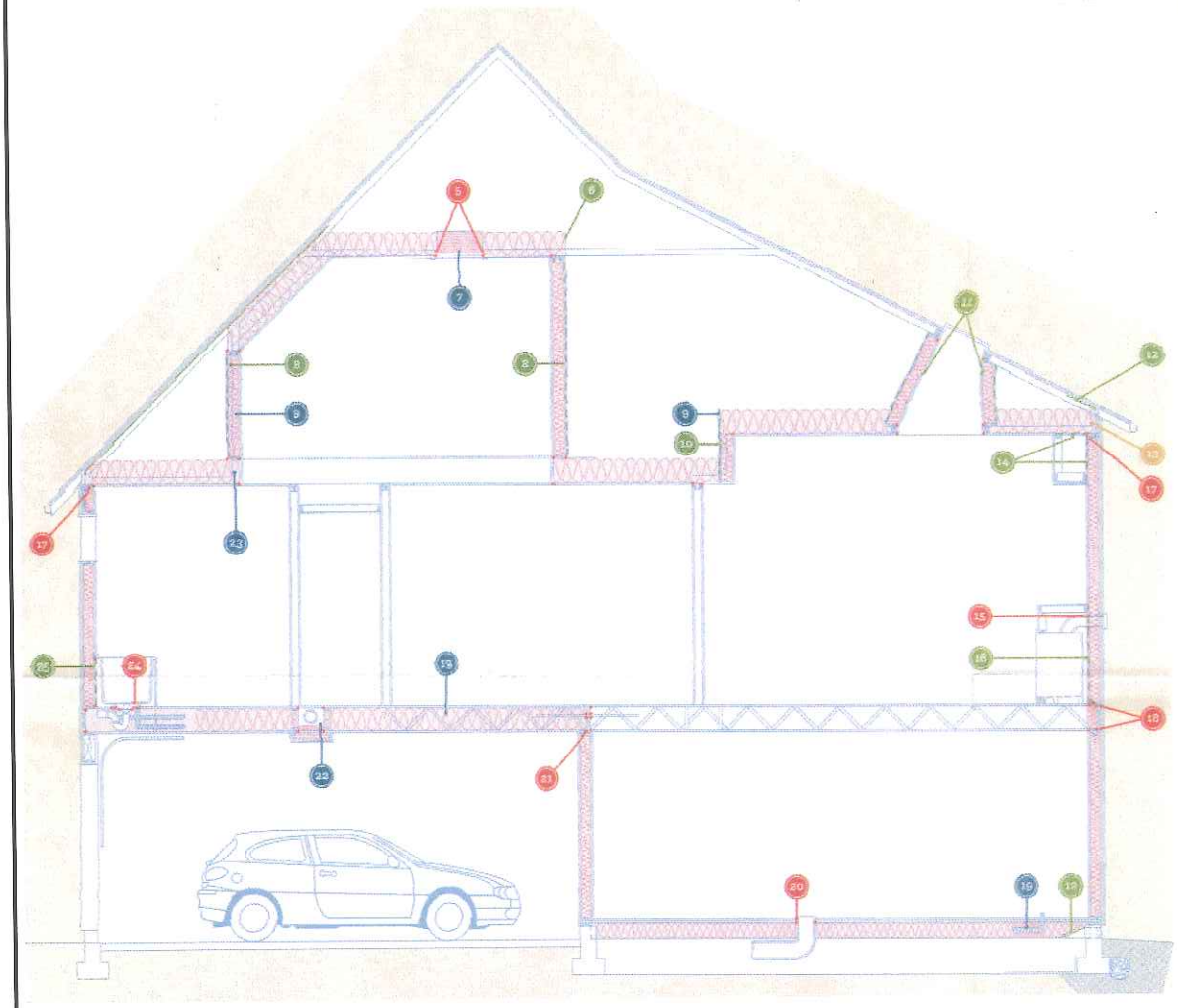
Types of Supply System: Trunk and Branch, Perimeter Loop, Radial

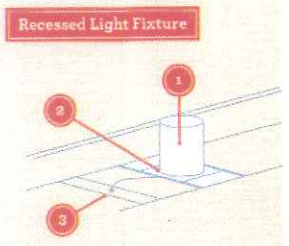
Construction Materials: Sheet metal, Fiberglass Ductboard, Rigid Round Fiberglass, Flexible Vinyl Duct, Fiberglass Duct Liner w/ Facing, Flexible Metal Duct

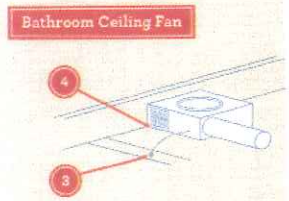
Recommended Velocity (FPM) (Manual D, Table 3-1)

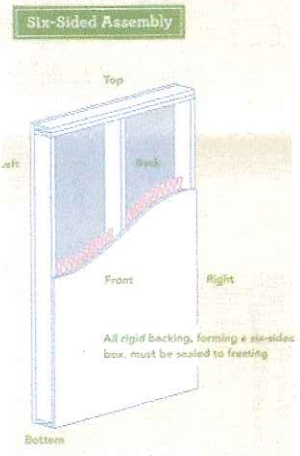
	Supply				Return			
	Recommended		Maximum		Recommended		Maximum	
	Rigid	Flex	Rigid	Flex	Rigid	Flex	Rigid	Flex
Trunk Ducts	700	600	900	700	600	600	700	700
Branch Ducts	600	600	900	700	400	400	700	700
Supply Outlet Face Velocity	Size for Throw		700					
Return Grille Face Velocity							500	
Filter Grille Face Velocity							300	

STANDARD CONSTRUCTION DETAILS
RESIDENTIAL THERMAL ENCLOSURE
BEST PRACTICES









Air Sealing

1 Use insulation contact airtight, or ICAT, rated can light fixture with rubber gasket
2 Seal can light to drywall
3 Seal electrical penetrations
4 Seal bathroom ceiling fan to drywall
5 Weather-strip attic access
15 Seal flue shaft with fire caulk
17 Seal Sheetrock to top plates at all attic-to-wall intersections
18 Caulk rim or band joist to subfloor and plates
20 Seal duct boots to subfloor
21 Install a continuous rigid air barrier or other supporting material to separate the garage from the conditioned space, and then air seal
24 Air seal plumbing penetrations

Air Sealing Points= ✦

Quality Installed Insulation

7 Insulate attic access
9 Use of R-23 insulation and backing required (fur out as needed)*
19 Make full contact with subfloor where insulation in floor cavities is detailed around plumbing and electrical
22 Provide full R-value of floor insulation under duct runs where ducts run over the garage
23 Block and air seal between attic and bonus room floor

Reduced Thermal Bridging

13 Use R-21 at inside edge of top plate

Fully Aligned Air Barriers

6 Install insulation dam as needed to maintain full height of ceiling insulation
8 Install rigid backing behind all knee walls*
10 Install rigid backing at stepped ceiling*
11 Install rigid backing on all skylight walls
12 Install baffles to prevent wind washing
14 Install rigid backing behind dropped soffit*
16 Install rigid backing behind fireplace sealed to framing*
25 Install rigid backing behind all tubs and showers*

Baffle= ————

*Six-Sided Assembly= — — — —
All rigid backing, forming a six-sided box, must be sealed to framing

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